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Modeling the non-thermal emission from stellar bow shocks

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Since the detection of non-thermal radio emission from the bow shock of a massive runaway star simple models have predicted high-energy emission from these Galactic sources. In this work we develop a more sophisticated model for the non-thermal emission from massive run-away star bow shocks. The main goal is to establish whether these systems are efficient non-thermal emitters or they are not capable of transforming a significant amount of their power into non-thermal radiation. For modeling the collision between the stellar wind and the interstellar medium we use 2D hydrodynamic simulations. We then adopt the configuration of the wind+ambient medium obtained with the simulation as the domain for solving the transport of energetic particles injected in the system, and the non-thermal emission they produce. For this porpoise we solve a 3D advection-diffusion equation in the test-particle approximation. We find that a massive runaway star with a powerful wind deposits a considerable fraction of its total wind kinetic power as non-thermal emission, mostly produced by inverse Compton scattering of relativistic electrons with dust-emitted photons, secondly by synchrotron radiation.

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